

## CLAIMS

What is claimed is:

1. An electron gun, comprising:  
a cathode having a longitudinal axis and operable to generate an electron beam along the longitudinal axis when driven by resonant electromagnetic radiation of a particular frequency;  
a cavity surrounding the cathode and operable to resonate when electromagnetic radiation of the particular frequency is introduced into the cavity; and  
an energy input coupled to the cavity and operable to introduce electromagnetic radiation of the particular frequency into the cavity along the longitudinal axis of the cathode.
2. The electron gun of Claim 1, wherein the cavity is axisymmetric around the longitudinal axis.
3. The electron gun of Claim 1, wherein:  
the electron gun further comprises a solenoid disposed around the cavity and operable to produce a magnetic field that reduces transverse emittance of the electron beam; and  
the solenoid is operable to be positioned at any point along the length of the cavity in order to adjust the amount of reduction of the transverse emittance of the electron beam.
4. The electron gun of Claim 1, wherein the cavity comprises:  
one or more booster cells; and  
an exit channel.
5. The electron gun of Claim 1, wherein:  
the energy input comprises a coaxial line having a center conductor; and  
the cathode comprises an extension of the center conductor of the coaxial cable.
6. The electron gun of Claim 5, wherein:  
the cathode is operable to be selectively positioned in the cavity so that changing the position of the cathode in the cavity changes the particular frequency at which the cavity resonates.
7. The electron gun of Claim 6, wherein the cathode is selectively positioned by a connector coupling the coaxial cable to the cavity.

8. The electron gun of Claim 1, wherein the cavity comprises an endwall operable to be selectively deformed to change the particular frequency at which the cavity resonates.

9. An electron gun, comprising:  
a cavity operable to resonate when electromagnetic radiation of a particular frequency is introduced into the cavity; and  
a coaxial line coupled to the cavity having a center conductor that extends into the cavity, the center conductor operable to produce an electron beam along a longitudinal axis of the coaxial cable when driven by resonant electromagnetic radiation of the particular frequency, wherein the coaxial line is operable to introduce electromagnetic radiation of the particular frequency into the cavity along the longitudinal axis of the coaxial cable.

10. The electron gun of Claim 9, wherein the cavity is axisymmetric around the longitudinal axis.

11. The electron gun of Claim 9, wherein:  
the electron gun further comprises a solenoid disposed around the cavity and operable to produce a magnetic field that reduces transverse emittance of the electron beam; and  
the solenoid is operable to be positioned at any point along the length of the cavity in order to adjust the amount of reduction of the transverse emittance of the electron beam.

12. The electron gun of Claim 9, wherein the coaxial line is operable to be selectively positioned to change the particular frequency at which the cavity resonates.

13. The electron gun of Claim 12, wherein:  
the coaxial line further comprises a threaded connector coupling the coaxial line to the cavity; and  
the coaxial line is positioned by adjusting the threaded connector.

14. The electron gun of Claim 9, wherein the cavity comprises an endwall operable to be selectively deformed to change the particular frequency at which the cavity resonates.

15. A method of generating an electron beam, comprising:  
providing a cavity operable to resonate when electromagnetic radiation of a particular frequency is introduced into the cavity;  
providing a cathode within the cavity operable to generate an electron beam along a longitudinal axis when being driven by resonant electromagnetic radiation of the particular frequency; and  
introducing electromagnetic radiation of the particular frequency into the cavity along the longitudinal axis of the cathode.
16. The method of Claim 15, further comprising:  
selectively adjusting the particular frequency at which the cavity resonates by repositioning the cathode; and  
introducing electromagnetic radiation of the new resonant frequency into the cavity along the longitudinal axis of the cathode.
17. The method of Claim 16, further comprising:  
reducing transverse emittance of the electron beam by disposing a solenoid around the cavity.
18. The method of Claim 15, further comprising:  
adjusting the particular frequency at which the cavity resonates by selectively deforming an endwall of the cavity; and  
introducing electromagnetic radiation of the new resonant frequency into the cavity along the longitudinal axis of the cathode.
19. The method of Claim 15, wherein:  
the electromagnetic radiation is introduced into the cavity by a coaxial line coupled to the cavity; and  
the cathode comprises an extension of a center conductor of the coaxial cable.